Annual Report

FOREST PEST CONDITIONS IN WISCONSIN

1964

WISCONSIN CONSERVATION DEPARTMENT

FOREST MANAGEMENT DIVISION

FOREST PESTS — SURVEY AND CONTROL

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A N N U A L R E P O R T

FOREST PEST CONDITIONS

IN

WISCONSIN

1964

FOREST PEST SURVEY AND CONTROL
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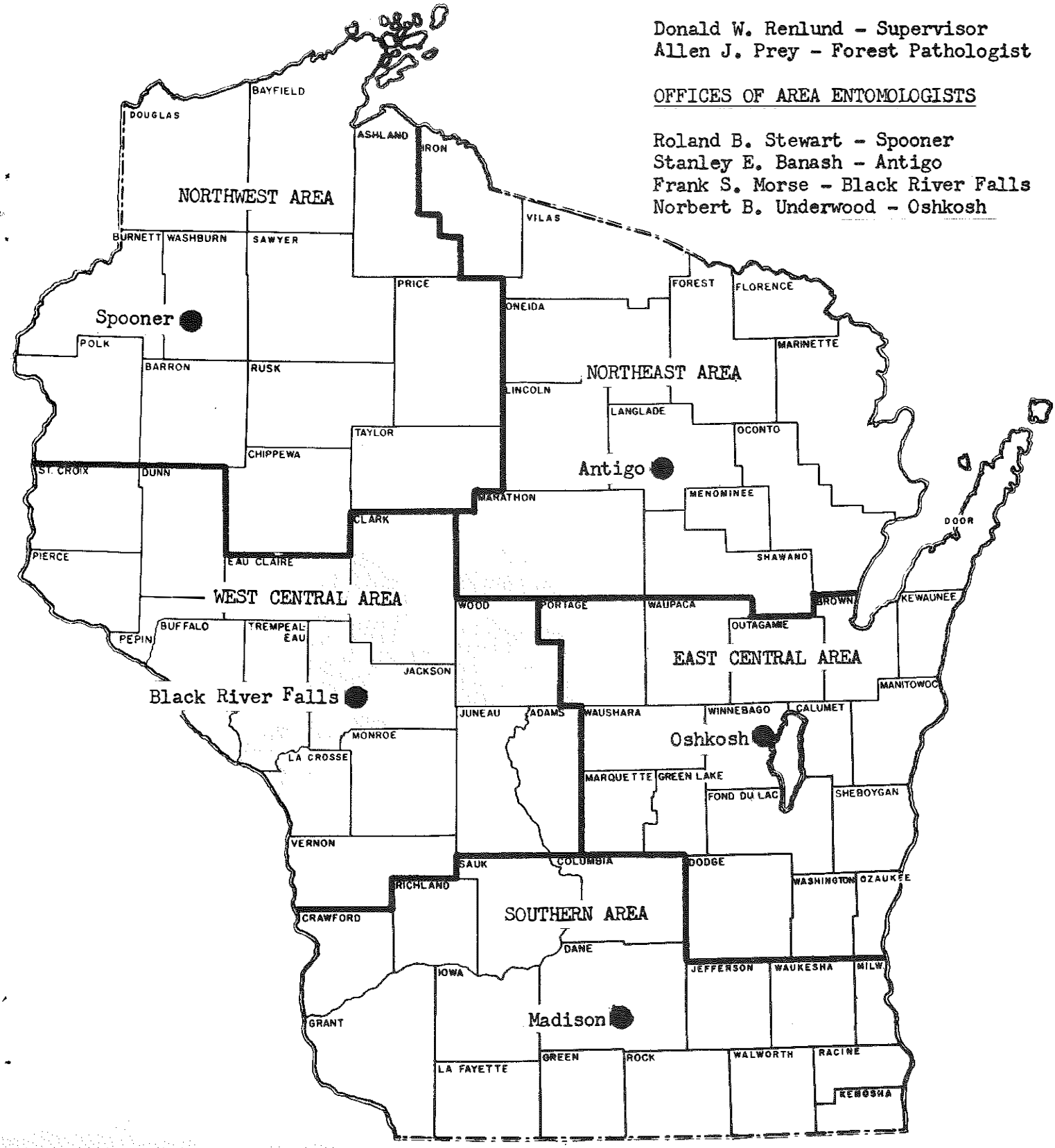


INTRODUCTION

Forest pest survey and control activities were varied and interesting, and added to our knowledge of the problems in Wisconsin. Voluntary observers in the Forest Management Division, and a few from other divisions and outside the Department, contributed valuable information on forest pests throughout the year. In addition efficient experienced crews were ready to participate in control operations whenever and wherever they were needed.

Continued enthusiastic cooperation by many others permitted continued progress where otherwise things might have come to a standstill. Noteworthy was the expansion of inter-agency pesticide residue investigations on treated and nontreated forest lands, which were started in 1962 in cooperation with the Wisconsin Department of Agriculture.

Participants in the 1964 residue investigations, in addition to the Game Research Section of the Department and the Department of Agriculture, included the University of Wisconsin Department of Entomology and the State Water Pollution Committee.

Plans were completed late in the year for a Forest Disease Survey which will be activated early in 1965. This will provide better balance to the overall survey and control program.

Numerous surveys were completed in the continuing effort to improve standards for evaluating pest problems and some use was made of chemicals to protect timber. Following are a few highlights of the year's activities:

Approximately 117,000 acres of jack pine were surveyed for pine tussock moth infestation. Intensive checks were made on 17,000 acres and chemical control was ultimately applied on 8,317 acres in Douglas County in May. Control was excellent. Summer checks of egg laying by the tussock moth indicated that about 12,000 acres of timber, outside the treated area, are threatened in 1965.

Approximately 6,000 acres of jack pine in several locations in Burnett and Polk Counties were found to have sufficiently high populations of jack pine budworm to warrant consideration of control with chemicals. However, further evaluation indicated that the use of chemicals may be avoided if removal of certain heavily infested mature trees can be accomplished through timber sales.

Eleven thousand acres of susceptible pine plantations were surveyed for Saratoga spittlebug in the Northeast Area, and spot checks were made of plantations in other areas. Chemical treatment was required on 42 acres in Menominee County and on 15 acres in Oneida County. Back-pack mist blowers were used to apply insecticide to "hot spots" within plantations with success.

Walkingstick egg, nymphal, and adult surveys were continued in Marinette, Eau Claire Counties, and in other infestations. Continued mapping of defoliation each year has shown a great reduction in acreage of defoliated timber during the last 8 years. The other surveys are providing clues as to why the population changes are taking place.

Surveys of hardwood defoliators in the Northeast Area and elsewhere provided information on activity of natural control factors which indicated that current outbreaks of hardwood leaf rollers and saddled prominent were not cause for immediate concern.

Surveys for Fomes annosus were conducted in each area through inspection of plantations and use of spore trapping techniques. The disease has not been found in the state.

Section personnel worked on the control of pests as follows:

. Tested four insecticides with portable mist blowers for control of the balsam gall midge.

. Summarized data from field tests of chlordane and heptachlor for white grub control.

. Treated slash in a 22-acre red pine plantation in Oconto County for bark beetle control.

. Supervised chemical control of white pine weevil on 94 acres of timber in the West Central Area and on 40 acres in the East Central Area.

. Mechanically removed infested leaders on a small acreage in the East Central Area.

. Gave technical assistance to a Christmas tree grower who treated a 300-acre infestation of pine tortoise scale by aerial application of insecticide.

. Experimented with several chemicals for control of the scale.

. Assisted with aerial application of herbicides on 1200 acres of release work.

. Prepared recommendations for control of Cylindrocladium root rot in nurseries after cooperating in research on the problem.

. Trained state parks personnel in oak wilt control methods.

. Assisted Christmas tree growers with a number of pest problems including pine root weevil, root collar weevil, scale insects, and needle blight.

. Serviced several hundred requests for assistance with pests of shade and ornamental trees and miscellaneous problems.

. Assumed much of the responsibility for planning and field work on an oak management research project.

. Cooperated with the University Extension Service in preparation of a handout on recognition and control of pests of young conifers.

Section personnel also participated in radio and television programs, the annual Christmas Tree Grower's Association meeting, field meetings with Christmas tree growers, the annual Forest Landowner's Clinic at Trees for Tommorrow, lectures to grade, high school, state university and University of Wisconsin students, teachers, Boy Scouts, and other groups, in presenting pest survey and control information and our role in the over-all conservation program to the public.

PESTICIDE RESIDUE STUDIES IN FORESTED AREAS IN WISCONSIN

By Donald W. Renlund, Supervisor
Forest Pest Survey and Control

Records of pesticide use on forested areas in Wisconsin indicate that the first aerial application was made in 1926 when calcium arsenate was used in an attempt to control the hemlock looper. From then until 1945, when DDT was first used in the state, records of other treatments are sketchy. In subsequent years, however, increasingly accurate records have been kept of chemicals, rates of application, and land descriptions treated. These records show that DDT, at the rate of one pound per acre, has been the principal compound used in combating defoliators and spittlebugs whenever an insecticide was required.

While insecticides have been applied to parcels of timber varying from a few acres to several thousands of acres annually during the past twenty years, they have not been the sole source of control of forest insect problems. Natural control factors and silvicultural practices have also played an important part, and have controlled outbreaks on far more acreage than has been treated with chemicals. Yet, they have not been effective enough at times, and have had to be supplemented by chemical applications.

Chemical control and its over-all effects on the biota have been closely scrutinized in Wisconsin by entomologists, and specialists in other biological fields representing many agencies. Cooperation between these agencies, which have the common objective of promoting the safest possible use of chemicals on our forests has been very gratifying.

To date no serious apparent detrimental effects have been encountered. This may, in part, be due to stringent control of applications from the ground and from the air, and to the skillful and conscientious work of pilots who have applied the chemicals.

In the fall of 1961, the staff of the Pesticide Residue Laboratory of the Wisconsin Department of Agriculture became interested in the evaluation of residues in previously treated forest areas, and comparing them with similar areas having no known history of treatment, and with some located in vicinities of agricultural lands.

Pre- and post-spray samples of tree foliage, ground flora, duff, and soil were collected in evaluating a pine tussock moth control operation conducted in June 1962. Fat samples were collected from deer and porcupines in the fall of that year from the treated area and elsewhere in the state. Similar sampling has continued annually and kinds of samples have been expanded to include water, bottom samples, and flora and fauna from certain lakes and streams.

The 1964 pine tussock moth control program was approved by the Conservation Commission contingent on the establishment of an acceptable biological evaluation program. Game research specialists designed a small animal trapping program which netted 260 specimens ranging from the pygmy shrew to snowshoe hares and a few birds. In addition, a study of the effects of ingesting treated larvae by day-old chicks was

conducted in cooperation with the university. Samples from deer totalled 109 by the fall of 1964, and more than 625 samples have been taken altogether.

Early analyses were made with a Beckman DK2A recording spectrophotometer, and after March 30, 1964 a new Jerrell-Ash, Model 28-710 gas chromatrograph has been used. Results obtained with one technique have been verified by one or more other techniques when they have been questionable. Although analyses of all samples have not been completed, so far it appears that there is no cause for alarm, even on areas where chemical applications on forested areas have been heaviest, but these investigations will continue. While it is recognized that they provide us with a superficial look at pesticide residues on the landscape, and interpretation of results is difficult, they do provide background data which should be useful in evaluating later changes in the residue picture.

Future sampling will be limited to the availability of accommodations for running analyses, and to types which may provide the most useful information. It is hoped that more sophisticated studies will be attempted in Wisconsin.

We are indebted to the Wisconsin Department of Agriculture for their voluntary and generous contribution in collecting and analyzing samples, and to many others who participated in getting this work started in the state.

MAJOR FOREST INSECTS

COLEOPTERA

Strawberry Root Weevil - Brachyrhinus ovatus (Linnaeus)

Shrubbery around Spooner (Washburn County) was severely injured by feeding and the insects were a nuisance in and around Northwest Area homes in late summer. Reports from Marquette, Outagamie, and Winnebago Counties stated that large numbers of weevils entered houses seeking overwintering quarters. The household nuisance continued through July and became worse late in the month in Sauk, Shawano, Outagamie, Richland, Waushara, Walworth, Vilas, Lincoln, Portage, and Washburn Counties.

Phenological Notes:

May 15	- Adult weevils were emerging in Langlade County.
May 24	- Larvae were pupating in Dane County.
May 29	- Adults emerging and migration into houses reported in Green Lake, Vilas, Waushara, and Columbia Counties.
June 5	- Larval feeding injuring strawberry plants in Dane County.
June 26	- Adults invading houses in Iowa, Waupaca Counties.
July 31	- Adults active over most of state.
August 31	- Activity decreased.

Calosoma Beetles - Calosoma calidum (Fabricius)
Calosoma frigidum (Kirby)
Calosoma scrutator (Fabricius)

C. calidum was an active predator on the cankerworms in the Montello area (Marquette County).

The other two species, particularly C. scrutator, was very active in a saddled-prominent infested area on Chambers Island (Door County). The large attractively colored beetles seemed to be everywhere in the litter on the ground and up in the trees in pursuit of the larvae (Heterocampa guttivitta (Walker)) when the infestation was visited on July 29.

Woodborers - Cerambycids

Borer activity was observed in trees killed or weakened by pine tussock moth defoliation in Douglas County in 1963. Trees weakened by several successive years of partial defoliation by the introduced pine sawfly were also attacked by woodborers in the northwest counties.

Black Hills Beetle - Dendroctonus ponderosae Hopkins

Surveillance of beetle-killed ponderosa pine brought into Wisconsin from South Dakota showed that the wood was promptly utilized and no problems have become apparent.

Eastern Larch Beetle - Dendroctonus simplex Le Conte

Adult beetles were collected on December 30 from larch which had apparently been killed late in 1964 in Section 17, T23N, R5W in Jackson County. The 10-acre area contained about $\frac{1}{4}$-acre patch of blown down trees from which the infestation had apparently started.

Oak Twig Pruner - Elaphidion villosum (Fabricius)

This insect was very numerous in parts of Barron, Douglas, Polk, Rusk, Sawyer, and Washburn Counties. Dropped branches and twigs which resulted from girdling created a nuisance on lawns and sidewalks.

Larvae were active in dropped twigs in Douglas County on July 22.

Pales Weevil - Hylobius pales (Herbst)

Damage by pales weevils continued in West Central Area Christmas tree plantations. Six-to-eight-year-old plantations were investigated in Monroe, Jackson, and Adams Counties where small patches of dead red pine became apparent in late summer. A combination of pales weevil (Larvae feeding outward from the root collar on roots) and bark beetle (Ips sp.) attacks were noted. Pales weevil attack appeared to be primary, followed by that of bark beetles. Damaged trees occurred in pockets of 15 to 90 trees.

Attempts to control pales weevil attack by treating freshly cut Christmas tree stumps with sodium arsenite were only partly successful. Many treated stumps had populations of pales weevil larvae in the early fall.

Fall feeding by adults destroyed terminals and buds of Scotch pine and caused an Adams County grower to market 7,000 trees below premium grade and one to two years before they were scheduled to be sold.

Feeding niches, presumably by this insect, were found in the Waupaca County Forest. Adult weevils were found on sample discs distributed in the area. No damage was noted on Scotch pine seedlings in the area. Large producers of Christmas trees in the county are aware of the damaging role of this insect and carry on cultural practices to prevent losses.

Root Collar Weevil - Hylobius radicis Buchanan

Northwest Area - Tree mortality and windthrow are still evident in infestations under observation, but incidence of damage is relatively low. New infestations were reported in Burnett County plantations, but to date tree mortality is negligible.

Northeast Area - Red pine windbreaks have been heavily attacked in Oconto and Marinette Counties. In some windbreaks up to 95% of the

trees have been windthrown. Infestations in Scotch pine plantings have been reported in Marathon and Shawano Counties.

West Central Area - Moderate damage continues in many plantations, particularly in Scotch pine. Some Christmas tree growers are treating Scotch pine during the 5th or 6th year after planting. A Jackson County grower treated 70,000 trees in 1964, and many others treated parts of their plantations.

East Central Area - Apparent decreasing evidence of damage is attributed to the removal and mortality of many host trees and to more intensive cultural practices and chemical control.

Southern Area - There has been no significant change in the status of the insect in the southern counties, where it has not been an important problem mainly because of the relative scarcity of suitable host material.

Pine Bark Beetles - *Ips* sp.

Northwest Area - An extremely dry season combined with pruning, thinning, and other cultural activities provided ideal conditions for build-up of bark beetle populations over the area. Scattered individual tree mortality occurred throughout the pine type, and occasionally groups of six to eight trees were killed. Young red pine plantings in Burnett, Douglas, and Bayfield Counties suffered some mortality where cultural work had been done the previous winter and spring. A ten-year-old red pine planting in Section 34 of T43N, R13W was damaged by beetles after jack pine wolf-trees were cut down, and an area of mature jack pine in Burnett County, which had been severely defoliated by introduced pine sawfly for several years, suffered considerable tree mortality from bark beetles during the year.

Northeast Area - Bark beetles were active in many localities, and jack pine plantings ranging from 6 to 30 feet in height were most severely affected. Mortality was high in jack pine reproduction on a Marinette County site following a spring harvest cut.

Secondary attacks occurred in jack pine previously infested with jack pine budworm in Section 19, T32N, R19E. Many of the trees had been top-killed and shoestring root-rot (*Armillaria mellea*) infections were common. Mortality in the 30-foot trees was estimated at 5% to 7% per acre, and thinning was recommended to increase vigor of the remaining trees.

Bark beetle attacks in young red pine plantings were reported from Lincoln, Marinette, Oconto, and Oneida Counties. Small patches of trees were usually affected and the principal treatment consisted of removing infested trees.

A heavy infestation occurred in a 25 year-old red pine planting in Oconto County. The 30-foot-tall trees had been commercially thinned late in the summer of 1963, and the tops and branches were left where they fell. This slash covering 22 acres in the NENE of Section 10, T27N, R20E, was treated on June 16 and 18, 1964 to reduce the bark beetle population. A county crew using 20 gallons of commercial grade Penta, costing $1.25 per gallon, spent 33 man-hours on the project. The total cost for labor and materials was about $75.

West Central Area - Bark beetle damage was high for a second year with numerous reports of infestations from all parts of the area. Shelterbelts in Buffalo, Dunn, La Crosse, Pepin, and Trempealeau Counties, scattered forest stands, and ornamental trees were affected. Severe damage was associated with thinning and release work in red pine plantations on the Black River State Forest and on private land in Jackson County.

Hail storms combined with drought conditions contributed to high beetle populations which killed many acres of jack pine in Jackson County and elsewhere along the storm tracks. See map on page 10.

East Central Area - Generally, only isolated decadent trees were attacked. Small pockets of infestation were observed on poor sandy sites such as old sand blows. Both red and jack pine were attacked.

Southern Area - Damage to single red and jack pine trees, or small groups of trees, was confined to those growing under adverse conditions. Prominent pockets of tree mortality continued to enlarge in red pine plantings on several calcareous outcrops in the southwestern counties.

Phenological Note:

May 11	- Oviposition galleries were being made in windthrown trees in Section 4, T21N, R3W in Jackson County.
May 26	- Adults were very active and freshly laid eggs were observed in galleries in northeastern counties.
July 1	- New adults were near ready to emerge from red pine in Sauk County (Section 3, T9N, R6E).
August 17	- New damage was becoming apparent in Jackson County.

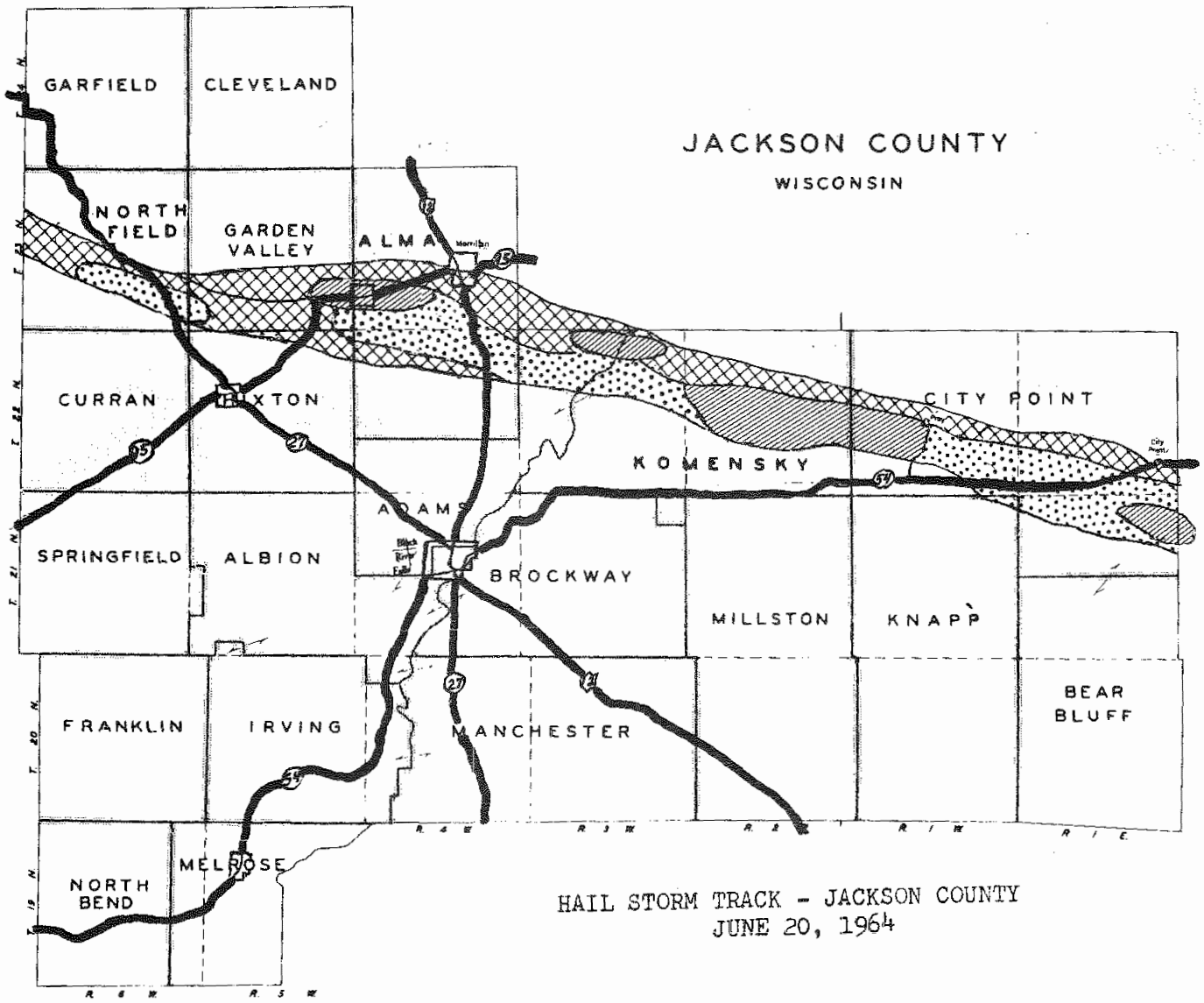
Black Elm Bark Weevil - *Magdalis barbita* (Say)
Red Elm Bark Weevil - *Magdalis armicollis* (Say)

These weevils were found in mechanically injured trees in Waushara and Winnebago Counties.

White Grubs - *Phyllophaga* sp.

Light damage was reported in new red pine plantings in Marathon County where larval populations were considered high at time of planting.

A few beetles were attracted to a light in Madison on May 8. Heavy flights of beetles were reported from near Hixton in Jackson County on May 14 and from Outagamie County on May 16, Dane County on May 18, and various other parts of the state as far northward as Taylor and Forest Counties. Some damage was reported to stock in an Outagamie County nursery. During the same period *Phyllophaga rugosa* was the species most frequently caught in Dane County blacklight traps, and 90% of those spaded up in sod were females of the same species according to the Wisconsin Insect Survey Bulletin dated May 29. The next most commonly occurring species were *P. fusca* and *P. implicita*.



Hail storms of June 20, 1964, caused major damage to forest stands in Komensky and City Point townships of Jackson County.

Agricultural and forest crops were damaged along the storm path from Buffalo to Adams counties.

In the Platteville area (Grant County) P. futilis was the dominant species followed by P. fusca, P. rugosa, and P. tristis, according to the same bulletin.

Numerous specimens of the parasite Pelecinus polyturator Drury were observed along a red pine windbreak near Merrill, in Lincoln County, on August 13.

- Pissodes approximatus Hopkins

A young red pine planting in Price County was attacked by this insect following severe winter injury. An area of about two acres was almost wiped out. No attacks were found on healthy trees in the vicinity.

White Pine Weevil - Pissodes strobi (Peck)

Populations were noticeably lower in the Northwest Area than in the previous year, and most stands of white and jack pine had less than one percent of the leaders infested.

Northeast Area white and jack pine sustained attacks on 10% or fewer leaders in most stands, while a young red pine planting in Menominee County in the SE$\frac{1}{4}$ of Section 33, T30N, R15E, had 40% of the leaders killed.

Weevil infestations were generally somewhat less a problem in natural stands and plantations in the West Central Area. Infested leaders ranged from 1% in La Crosse County to 36% of the leaders in some Clark and Jackson County stands.

Chemical control was supervised on 79 acres of white pine plantations in the Clark County Forest, and on 16 acres in Wildcat Mountain State Park (Vernon County). Treatment consisted of application of 1% DDT sprays to pine terminals with back-pack sprayers. Evaluation in the fall indicated that less than 1% of the treated trees had become infested while infestations in nearby untreated stands ranged from 2% to 25%.

Lindane-aroclor sprays were applied to white pine terminals on a 48-acre planting in the Jackson County Forest in November, 1963, to test the effectiveness of fall treatment. Evaluation in September, 1964, showed that 7% of the terminals were infested in the treated trees, and 36% of the untreated terminals were damaged. Apparently the fall treatment was not as effective as spring treatments had been with DDT.

In the East Central Area the number of currently attacked leaders was not significantly less than in 1963, but the carry-over population was much lower. For reasons unknown, relatively few insects were successful in maturing. Dry weather may have been a contributing factor.

Weeviling is generally scarce in the Southern Area but some occurs in the northern counties of the area.

Phenological Notes:

April 20 - Weevils were first observed feeding in Douglas and Shawano Counties.

April 23 - First active weevil adults were observed in Jackson County.

July 10 - Pupation near complete in Waushara County.

July 24 - Adults emerging from white pine leaders on July 24 at Wild Rose Hatchery in Waushara County.

- Pityogenes hopkinsi Sw.

This small reddish-brown beetle has been observed attacking its favorite host, white pine, which has been weakened by blister rust or feeding by the white pine aphid. Apparently healthy white pine has been attacked where freshly cut logs have been piled against them.

Hickory Bark Beetle - Scolytus quadrispinosus Say

A buildup of these beetles contributed to mortality of hickory trees in Balsam Lake and surrounding area in Polk County.

DIPTERA

Balsam Gall Midge - Cecidomyia balsamicola (Lintner)

The gall midge was active in varying degrees in natural and planted balsam fir. Christmas tree growers in Langlade, Lincoln, Oneida, and Vilas Counties appeared to be most troubled by the pest. In plantations where midge activity was observed closely, the most severely infested trees were on east or north exposures.

Trees within the shade patterns of adjacent hardwoods appeared to be most subject to attack. Traps were devised and used in plantations to obtain data on peak emergence of adults from the duff. Emergence spanned about one week with the maximum number of adults appearing over a three day period. Oviposition was frequently observed in the evening when temperatures were in the mid-sixties.

Tests of chemicals made in a Langlade County plantation in 1963 were repeated, and control was most effective when treatments were applied when less than 5% of the buds were open. DDT, lindane, methoxychlor, and phosphamidon were used in the tests. DDT and lindane appeared to be most effective.

Several growers applied DDT to their plantings with back-pack compression sprayers or portable mist blowers. While effectiveness of control varies, results were mostly satisfactory.

Phenological Notes:

May 7 - Balsam fir buds began opening in Langlade County.

May 11 - First adults of the season observed in Langlade County.

May 16 - Peak adult emergence in traps.

June 8 - Galls were readily visible at bases of infested needles.

Pitch Midge on Jack Pine -

Populations continued high in parts of Douglas and Bayfield Counties. Twig mortality continued in some locations and tree deformity attributable to midge injury was observed.

Red Pine Needle Midge - Thecodiplosis piniresinosae Kearby

No reports of activity were received and no damage was observed in 1964.

HEMIPTERA

Pine Spittlebug - Aphrophora parallela (Say)

Massive spittle accumulations, covering the entire upper trunks of trees in some stands, were observed on jack pine in Polk County. No subsequent tree mortality was apparent.

The spittlebug was also plentiful in Adams, Monroe, Juneau and Jackson Counties, and scattered infestations were observed in Marquette, Waupaca, and Waushara Counties.

Phenological Notes:

May 21 - First instar nymphs were observed in Adams County.

June 5 - Nymphs were mostly in the 5th instar in Waupaca and Waushara Counties.

June 8 - Nymphs were in the last instar in Adams County.

June 19 - Adults were first observed in Polk County.

Saratoga Spittlebug - Aphrophora saratogensis (Fitch)

Populations continued to be very low in the Northwest Area. Approximately 11,000 acres of pine plantings were surveyed in five Northeast Area counties. Low nymphal populations were attributed mostly to drought conditions that destroyed many of the nymphs in 1963.

Chemical control was required on only two plantations. A mistblower was used to treat 42 acres of a 60-acre plantation in Menominee County (SE$\frac{1}{4}$ of Section 26, T30N, R15E). DDT with aroclor was applied at a rate of slightly less than one-half pound per acre in 4 man-hours working time. A 15-acre planting within a large block of scattered plantings in Oneida County (NWSE of Section 36, T39N, R5E) was treated similarly. Landowners supplied manpower and the insecticide, and made the applications with the Department's machine the last week in July. Post-spray scar counts made on new shoots and second year internodes in November indicated that the control effort was successful.

Although egg counts had been high in the fall of 1963 on county and state forest lands in Jackson County, no control was required. Nymphal populations in July, 1964 were in the low and medium ranges, and it appeared that hot, dry weather in June may have been responsible for the drop. Jackson County plantations treated by mistblower in 1963 appeared to have been well protected.

Little trouble from the Saratoga spittlebug is anticipated in 1965.

Phenological Notes:

May 19 - About 2/3 of the spittlebug eggs were hatched in the northeastern counties. Red pine candles were $1\frac{1}{4}$" long.

May 21 - Nymphs were in the first instar in Adams County in NWNW of Section 25, T19N, R7E.

June 23- Newly-emerged adults were first observed in Jackson County in NENE of Section 11, T20N, R4W.
60% of the nymphs observed in the Marinette County Forest were in the 3rd instar.
95% of the nymphs observed in Lincoln County were in the 4th instar.

July 3 - Most nymphs were in the 5th instar in the northeastern counties.

July 14- Adult emergence was 95% completed in Menominee and Oneida Counties.

Pine Tortoise Scale - Toumeyella numismaticum (Pettit & McDaniel)

Northwest Area - High populations which built up in some localities in 1963 on jack pine collapsed due to natural controls. Very little tree mortality occurred in the infested areas. Predation by unidentified lady beetles appeared to be a major factor in the decline.

Some build-up of the scale was noted in Sections 17 and 20 of T45N, R10W, in Douglas County, which were included in spray blocks treated for pine tussock moth control in 1964.

Northeast Area - Heavy infestations were reported on Scotch pine plantings in Vilas and Oneida Counties.

An infestation, which had persisted for two years in Florence County Forest jack pine plantings, collapsed. The population reduction appeared to have been brought about mostly by predation by the twice-stabbed lady beetle (Chilocorus stigma (Say)).

West Central Area - Moderate infestations were reported in Scotch pine Christmas tree plantations in Clark, Jackson, and La Crosse Counties. From 2% to 5% of the trees in these plantations had heavy scale infestations.

About 300 acres of infestation were treated in Jackson and La Crosse Counties by two Christmas tree growers on June 12. Aerial application

of 3/4 pound of malathion in one gallon of No. 2 fuel oil per acre resulted in good control. No live scale colonies were found when follow-up checks were made in late summer, and although brown spots appeared on the wild cherry and poplar leaves in the plantation within 72 hours after treatment, no injury occurred on Scotch pine, white spruce, or balsam fir. Lady beetle larvae were active on the treated trees when the 72 hour check was made.

Chemical control tests were initiated on infested trees in another Jackson County plantation. Diazinon, malathion and phosphamidon were applied with hand sprayers immediately before crawler emergence on June 3 in one test, and another group of trees were treated on July 11 after crawlers were well established. Diazinon gave excellent control; while phosphamidon and malathion gave good control.

East Central Area - Two localized heavy infestations failed to materialize on Scotch pine Christmas trees in Waushara and Waupaca Counties due to predation by larvae of the lady beetle *Anatis quindecimpunctata* (Olivier). In each instance the predators were so numerous the owners assumed they were dangerous pests, and perhaps required control.

In another instance a commercial applicator sought advice from an entomologist before destroying lady beetle larvae which had been assumed to be scale insects in another Christmas tree planting. No treatment was needed, or applied.

Phenological Notes:

June 1 - Adult scales with eggs, no crawlers apparent in Jackson County.

June 4 - Crawlers started to emerge in Jackson County.

June 12 - Some crawlers were settled, starting to secrete "shells" in Jackson County.

June 20 - Crawlers were emerging in Oneida County.

June 22 - Crawlers were emerging in Bayfield County; near-mature lady beetle larvae were working on the scales.

May 7 - Black coccinelids with a single red spot on each wing cover, and 12-spotted lady beetles were everywhere in the Bayfield County infestation, flying and mating. No eggs were observed under the scales. Male flowers were starting to appear on the jack pine which had candles up to 2 inches long.

July 8 - Crawlers were settled on new growth of jack pine in Bayfield County, and cast skins indicated some of them had molted twice. A few lady beetle larvae were still working on the scales, but most had disappeared, presumably to pupate.

HYMENOPTERA

Maple Petiole Borer - Caulocampus acericaulis (MacGillivray)

About 3% of the sugar maple leaves on trees in the Big Lake area in Vilas County were infested. On June 10 a few larvae were still around but most had pupated and many of the chambers were empty.

Introduced Pine Sawfly - Diprion similis (Hartig)

Spring populations were low in the northwest counties, and although late summer larvae were more plentiful in a few localities no severe defoliation resulted. An area of defoliation in jack pine was reported in Burnett County (Sections 16,17, and 20 of T39N, R14W) after deer season. It was apparent that populations had been high in this particular stand for three or four years, and some of the larger trees had been weakened to the point where bark beetles and wood borers had moved in and were causing tree mortality.

Elsewhere in the state little activity was reported. Several light infestations were reported from the eastern half of Vilas County, most of them late in the season. A few larvae were found in northwestern Waupaca County near Clintonville.

Second instar larvae were observed on Scotch pine in Langlade County (T32N, R9E) on June 24; and they were in 3rd to last instars on August 13.

Larch Sawfly - Pristophora erichsonii (Hartig)

Northwest Area - Little defoliation was apparent and cocoons were scarce in most tamarack stands in the fall of 1964. On many trees examined, oviposition injury was heavy but little defoliation had occurred. It appeared that egg parasitism, or larval mortality, or both had been high.

Northeast Area - A few reports of light infestations were received from Marinette and Oneida Counties. Populations generally remained low as they were the preceding two years.

West Central Area - Defoliation was light to moderate in most stands. On survey plots an estimated 40% to 60% of the available foliage was consumed.

East Central Area - Evidence of current oviposition was noted with little defoliation and no larvae. Larvae were apparently attacked by predators. Red-winged blackbirds were numerous in areas examined.

Southern Area - Defoliation was negligible.

Phenological Notes:

June 2 - Scattered light defoliation was apparent in Lincoln and Sawyer Counties.

August 12 - Larvae observed in northern counties were in the 3rd to 5th instars.

Red-Headed Pine Sawfly - Neodiprion lecontei (Fitch)

A few scattered colonies on jack pine were reported from Polk, Burnett, Washburn, and Douglas Counties in the Northwest Area, and on red pine in Marinette, Oconto, and Langlade Counties in the Northeast Area where populations have been low the past three years. While more colonies were reported in Door County than previously, they were still few and widely scattered, and nowhere in the state was significant injury encountered.

Larvae were in the second and third instars in Marinette County on August 3, and near mature in northwest counties on August 10.

Red Pine Sawfly - Neodiprion nanulus nanulus Schedl

Very little defoliation resulted from the few colonies reported in Washburn and Burnett Counties, and elsewhere in the state. In Marquette County larvae of the jack pine sawfly, Neodiprion pratti banksianae Rohwer were found in the same localities and often on the same trees as those of the red pine sawfly.

Phenological Notes:

May 26 - Larvae were in the third instar in Oconto County.

June 1 - Cocooning was near complete in the southern counties.

White Pine Sawfly - Neodiprion pinetum (Norton)

A number of colonies were collected on October 6 in Section 4, T10N, R19E. The larvae had survived subfreezing temperatures and were reared to maturity. A single report was received from Vernon County where a few trees were defoliated, and scattered reports of defoliation of individual trees were received from observers in the southern counties.

Larvae were near mature in Dane County on July 22.

Jack Pine Sawfly - Neodiprion pratti banksianae Rohwer

Colonies were numerous in Douglas County but no serious defoliation resulted.

- Neodiprion virginianus complex

A small outbreak in Trempealeau County in 1963 caused considerable mortality of jack pine, but did not spread into nearby plantations before it collapsed. Larvae that hatched in August, 1964 died before they caused any damage.

LEPIDOPTERA

Pine Tussock Moth - Dasychira plagiata (Walker)

A potentially destructive pine tussock moth infestation continued to persist on approximately 17,000 acres of jack and red pine in

Douglas County through the winter of 1963-64. The infestation covered parts of the following townships:

43 North, Range 11 West
44 North, Range 11 West
45 North, Range 10 West
45 North, Range 11 West
46 North, Range 10 West

It threatened trees of all ages in natural stands and plantations. The combined effects of drought and severe defoliation weakened many trees to the point where little or no additional defoliation could be tolerated. This situation prompted formulation of plans for control with chemicals in the event it was needed in the spring of 1964. (See map on page 19).

Continued surveillance of the infestation during the dormant season provided detailed information on stand conditions, cutting schedules, and population behavior which permitted a substantial reduction in the acreage considered for treatment. A fungus of questionable virulence which had been observed under bark scales on larval remains in 1962 was again noted. A few larvae apparently killed by a virus were collected in the area. Meteorus parasites encountered were numerous in some locations, but numbers were few in contrast to those found in 1963. Although calosoma beetles had been very active in a few spots the previous year, none were found working on the population in the spring of 1964.

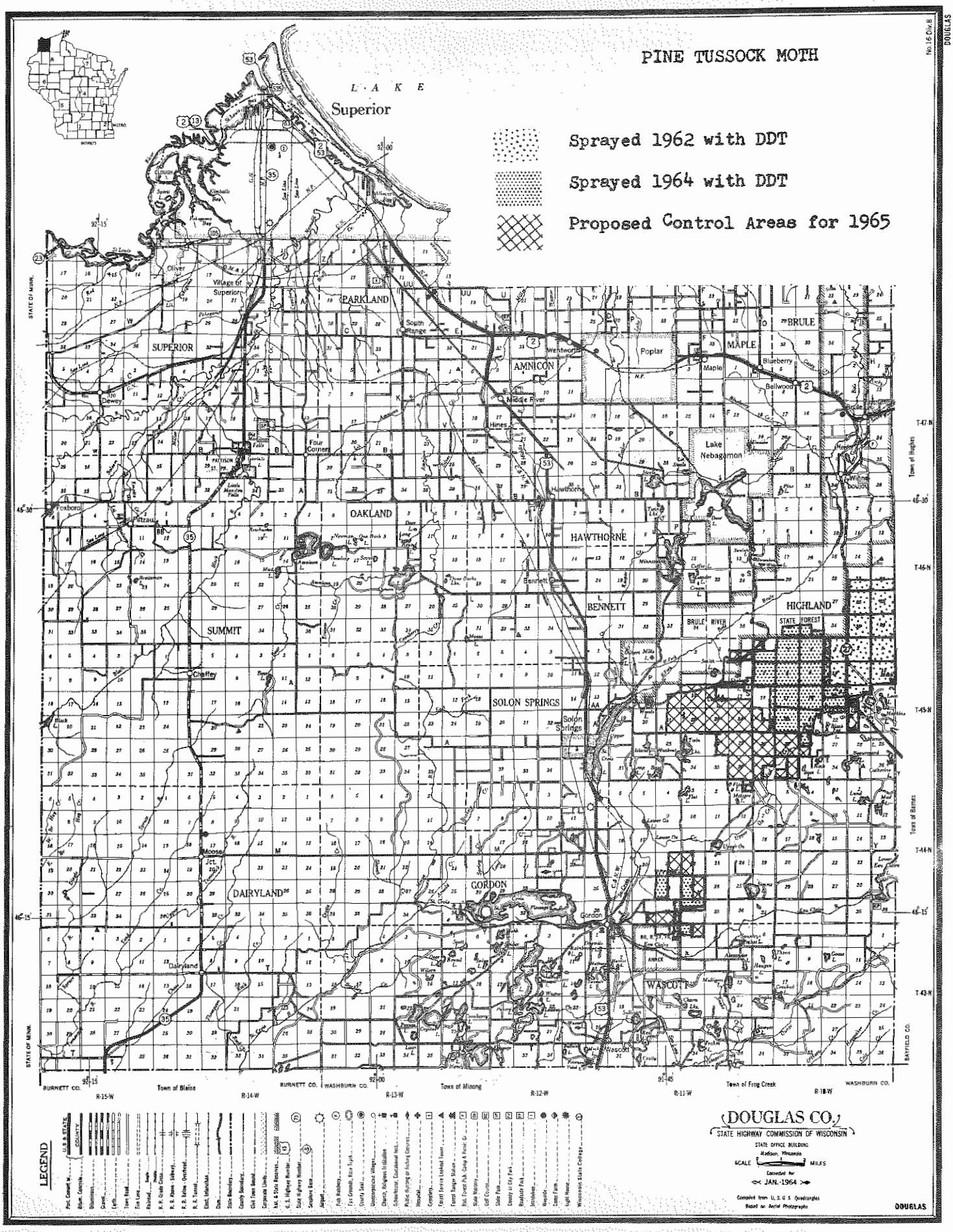
The final decision to proceed with chemical control, as authorized by the Commission, was made in late April when it was quite apparent that natural control was not going to reduce the threat by the tussock moth.

Bid invitations were in the mail on May 13 to fifteen aerial applicators, and when bids were opened on May 22 there were two qualified bidders. The low bid for supplying insecticide and making the application was for $1.93 per acre, and the other for $2.75 per acre. The contract was awarded to the Ueding Flying Service of Vincennes, Indiana.

The control operation started on the morning of May 28 and was completed the morning of May 29. Four Stearman aircraft operated by pilots with agricultural flying experience ranging from a minimum of 1,900 hours to more than 5,000 hours executed the job efficiently. Radio-equipped ground crews made up of experienced personnel, mostly from the Northwest Area, guided the aircraft over each spray block, and an observation plane monitored the project from the air.

One pound of DDT per gallon per acre was applied on 7,257 acres and one-half pound of DDT per gallon per acre was tried on selected fringe acreage where it was felt a lesser amount of insecticide might work.

A study of effects of spraying on inhabitants of treated areas, requested by the Conservation Commission, was planned and conducted in cooperation with the Game Research Section, the State Department of Agriculture, and the University. This study was supplemented by an even broader study of pesticide residue distribution which has been continuing since the fall of 1962.


PINE TUSSOCK MOTH
Sprayed 1962 with DDT
Sprayed 1964 with DDT
Proposed Control Areas for 1965
LAKE Superior
SUPERIOR
PARKLAND
AMNICON
MAPLE
BRULE
OAKLAND
HAWTHORNE
BENNETT
HIGHLAND
SUMMIT
SOLON SPRINGS
DAIRYLAND
GORDON
WASCOTT
Lake Nebagamon
Town of Hughes
Town of Barnes
Town of Blaine
Town of Minong
Town of Frog Creek
BURNETT CO.
WASHBURN CO.
BAYFIELD CO.
STATE OF MINN.
LEGEND
DOUGLAS CO.
STATE HIGHWAY COMMISSION OF WISCONSIN
STATE OFFICE BUILDING
Madison, Wisconsin
SCALE MILES
Corrected for
JAN.-1964
Compiled from U.S.G.S. Quadrangles
Based on Aerial Photographs
DOUGLAS

Personnel from the state Water Pollution Committee, the state Department of Agriculture, the University, and the Department joined in planning collections and collecting samples of vegetation, soil, silt and water from lakes and streams, fish and other aquatic fauna, from within and outside the treated area before and after treatment. Samples are being analyzed by gas chromatography, at no cost to the Department, by the Department of Agriculture.

Evaluation by University and Department entomologists of the tussock moth population reduction due to spraying indicated that one pound of DDT per acre produced excellent results, while half-pound per acre did not provide as good control. Egg counts made in late summer indicated moderately high populations might be expected in the spring of 1965 in stands treated at the lower rate, and it was apparent that the outbreak had not subsided in stands to the southwest of the treated area. Prehibernation feeding by larvae in August produced little browning of tree tops compared with that of past years, even where egg and larval counts were highest.

Egg parasitism was low and overwintering larval populations were high enough on 12,000 acres to warrant consideration of additional chemical control in the spring of 1965 unless an adequate population reduction occurred naturally before then.

The Wisconsin Forest Pest Act, Chapter 26.30 of the Statutes, provides for sharing of control costs when an insect or disease, such as the pine tussock moth, presents a threat to the forest resource of the state, and when a practical means of controlling the pest is available.

Costs of treatment may be shared as follows:

The state may pay all costs on lands treated up to the first 160 acres per owner in a county, plus one-half the cost of the insecticide and its application on the remaining acreage requiring treatment, and all overhead and survey costs before and after treatment.

Federal financial support of a control project may amount to 25% of the total cost of the project, thus reducing the state's share, and the landowner's share. Federal funds were available for the 1964 control project.

The following tabulations summarize acreage treated in 1964 by ownership classes, cost of the operation, and distribution of costs:

OWNERSHIP CLASSES	ACREAGE TREATED
Private Industry	7,401
State	423
Other Public	200
Other Private	293
Total	8,317 Acres

COST OF THE 1964 PINE TUSSOCK MOTH CONTROL

1.	Insecticide and its application:	
	8,317 Acres @ $1.93/Acre =	$ 16,051.81
	less 1% discount	160.52
		15,891.29
2.	County Forestry Participation	967.55
3.	Pest Control Section Participation	5,189.37
4.	Evaluation Crew and Other Costs	808.86
	Total Cost	$ 22,857.07

DISTRIBUTION OF TOTAL COSTS

	Contribution	% of Total	Share/Acre @ $2.75/Acre
State	$ 12,024.44	53	1.44
Federal	5,714.27	25	.69
Private Landowners	5,118.36	22	.62
Totals	$ 22,857.07	100%	$2.75/Acre

Phenological Notes: (Douglas County)

April 28 - Larvae broke hibernation in Douglas County. Feeding was slow due to cool, wet weather.

May 22 - Larvae were mostly in the 3rd instar in Douglas County.

May 29 - Larvae ranged from 3rd to 5th instar, predominantly 4th.

June 22 - First pupa observed.

June 30 - About 15% of the larvae had pupated.

July 8 - About 60% of the larvae had pupated. Eggs were readily found. Near mature larvae which had stripped foliage from red pine were feeding on scrub oak along the edge of the plantation.

July 19 - Light trap collections indicated peak of moth flight reached.

July 27 - Major oviposition completed. First hatched eggs observed.

August 4 - Approximately 40% of egg masses hatched.

August 10 - About 95% of egg masses hatched. Egg parasitism appeared to be low.

August 17 - 60% of the young larvae had hibernated. Browning of tree tops, due to feeding by new larvae, was becoming apparent in the untreated trees near Gordon.

August 21 - 90% of the young larvae were hibernating.

Zimmerman Pine Moth - Dioryctria zimmermani (Grote)

Little damage was reported in the Southern, and West and East Central Areas. Infestations were mostly in Scotch pine windbreaks and Christmas tree plantings.

Saddled Prominent - Heterocampa guttivitta (Walker)

A 200-acre infestation on Chambers Island, which had been investigated in 1963, appeared to be at the point of collapsing when the island was visited on July 29, 1964. A few larvae ranging from 4th to 6th instars, but mostly in the 5th, were found almost everywhere on the island feeding on hard maple, birch, beech, and basswood. Coloration of larvae ranged from pale green to yellow with pale to deep purple markings. Underbrush appeared to be most sparse where the remaining infestation was heaviest. Calosoma beetles, mostly Calosoma scrutator, and a lesser number of Calosoma frigidum, were very actively searching out and destroying the caterpillars on the ground and in the trees. Some larvae appeared to be diseased, and a few hundred collected in new polyethylene bags for rearing in the laboratory died shortly after being placed in rearing cages. Specimens of the diseased larvae were given to the insect pathologist on the Lake States Experiment Station staff for a determination of the possible cause of the mortality.

Forest Tent Caterpillar - Malacosoma disstria (Hubner)

No defoliation by this insect was reported from any part of the state during the year. About ten nearly mature larvae were observed on the bole of a tree in the NWNE of Section 22, T27N, R6E (Marathon County) on June 1.

Fall and early winter egg mass surveys in the northern counties did not reveal any egg masses.

Olethreutid - Rhyacionia sp. (not buoliana or neomexicana. Close to frustrana and bushnelli, but not typical.)

Damage by this insect was found again in Waushara County, but an attempt to rear the insect through the adult stage was unsuccessful. Injury to new growth of red pine resembles that of the European pine shoot moth.

- Sparganothis sulfureana Clemens

Larvae were observed feeding on jack, Scotch, and red pine at various locations in Eau Claire County on July 10. These solitary feeders were quite scarce. Specimens were identified by Dr. R. D. Shenefelt at the University of Wisconsin.

Maple Blight Associates - Leaf Rollers:
Acleris chalybeana (Fernald)
Sparganothis acerivorana (McKay)

Maple Webworm:
Tetralopha asperatella (Clem.)

An increase in leaf roller activity prompted close observation of the insect complex which was implicated as a primary incitant of maple blight that occurred, principally in Florence County, in the late 1950's. Since rolled leaves provide oviposition sites for the webworms, an increase in their numbers and defoliation of hard maple were anticipated.

S. acerivorana populations ranged from light to moderate over several thousand acres of mature hardwoods in Menominee County where light webworm defoliation had been discernible on about 2,000 acres late in the summer of 1963. Rolled leaves per tree varied from a few to about 30% on the more heavily infested trees. The same leaf roller infested several hundred acres of timber near Goodman in Marinette County, but was heaviest on 60 acres just southwest of the community.

The Newald area, which includes the southwest corner of Florence County and adjoining sections in Forest County, contains thousands of acres of mature northern hardwoods which had light to moderate populations of leaf rollers. Here most of the rolled leaves had dropped to the ground and the leaf rollers had pupated by late June. The leaf-drop reduced the number of oviposition sites for the maple webworm.

Leaf roller populations were negligible throughout the large blocks of mature northern hardwoods in Florence County which were in the principal maple blight area of 1957 and 1958.

Main areas of infestation were the following: SESE of Section 4, T36N, R17E, and adjoining Sections 5, 8, 9, 16, 17, 20, and 21 in Marinette County; NW$\frac{1}{4}$ of T29N, R13E, and SW$\frac{1}{4}$ of T30N, R13E in Menominee County; Section 32, T38N, R15E in Florence County and Section 5, T37N, R15E in Forest County.

A. chalybeana was moderately abundant in Menominee County hardwood stands and on the Goodman tract in Marinette County. The old maple blight area in Florence County and the Connor Lumber Company tract in Forest County had light populations.

Both species of leaf rollers were heavily parasitized. Apanteles sp. cocoons were collected from many of the rolled leaves during the first half of July, and it appeared that about 20% of the S. acerivorana larvae in the Menominee County infestation had been affected by parasitism or predation.

Between 10% and 50% of the rolled leaves were utilized by webworm moths as oviposition sites in various locations, and leaves rolled by A. chalybeana seemed to be preferred for oviposition. Of the rolled leaves examined, about 23% were found to contain webworm eggs. Subsequent examinations of leaves indicated that the average colony of webworms contained 4 larvae, with a maximum of 17 encountered. The counts were substantially less than they had been in 1956 and 1957.

Anticipated defoliation by webworms did not materialize in any of the areas. Light defoliation was not discernible when aerial surveys were completed in late August, although moderate defoliation was apparent on scattered individual trees.

Phenological Notes:

May 22 - S. acerivorana larvae in the 1st and 2nd instars were feeding in newly developing leaves in Menominee County.

June 3 - S. acerivorana larvae were in the 4th and 5th instars in Menominee County, and Marinette County.

June 16 - S. acerivorana moth emergence was nearly complete in Section 32, T38N, R15E, in Florence County. 1st instar A. chalybeana larvae were noted in Section 5, T37N, R15E in Forest County.

June 19 - Most larvae of A. chalybeana were in the 2nd instar in Menominee County, and most S. acerivorana were in the last instar or had pupated.

June 29 - First eggs of T. asperatella were noted in rolled leaves in Forest County.

July 9 - 22% of randomly picked rolled leaves in Menominee County contained webworm eggs.

July 13 - 23% of the rolled leaves examined in Marinette County contained webworm eggs. 60% of the eggs had hatched and larvae were in the 1st instar. Apanteles cocoons were common in the rolled leaves.

July 27 - A few near mature A. chalybeana larvae were found in rolled leaves in Menominee County, but most of the leaf rollers had pupated. Webworm larvae were in the 1st and 2nd instars and one rolled leaf in 150 examined contained unhatched webworm eggs.

Cankerworms - Fall Cankerworm - Alsophila pometaria (Harris)
Spring Cankerworm - Paleacrita vernata (Peck)

Cankerworms were reported from scattered locations in Adams County where elm and oak were lightly defoliated; and from northern Jackson County where small numbers of ornamental elms were defoliated. A few larvae were observed on heavily defoliated elms near Alma Center on June 9.

Defoliation also occurred in the vicinity of Montello and Buffalo Lake and south of Westfield along U.S. Highway number 51 in Marquette County. The Montello infestation, which was older than that in the Westfield vicinity, appeared to be in its last year. Other insects, spiders, and birds had a combined effect in decimating the cankerworm population. Calosoma calidum, the fiery hunter, was perhaps the most common predator, and Apanteles cocoons were observed on a number of larvae. The Calosoma beetles appeared to be most abundant and active in areas which afforded them the best protective cover on the ground.

Defoliation in infested Columbia County wooded areas was variable and not as severe as it had been the two previous years, in specific stands examined, but the infestation was a little more widespread. Severe late spring frosts made it difficult to estimate defoliation.

Phenological Notes:

May 21 - Larvae up to 3/4" long and several collected in Sections 6 and 7, T13N, R7E, with white spherical eggs attached to various parts of the body.

June 5 - Larval development near complete in Columbia and Marquette Counties. Wasps, lady beetle larvae, and adult Calosoma beetles were active in infested areas.

June 18 - Pupation of cankerworms was near complete in southern counties.

June 26 - Evidence of beginning refoliation was apparent in some localities.

Large Aspen Tortrix - *Archips conflictana* (Walker)

Noticeable defoliation was apparent in Ashland, Price, and Rusk Counties aspen stands, and a few localized areas in Price County were completely defoliated. Lincoln, Langlade, Oneida, and Vilas Counties had the most severe defoliation in the Northeast Area and difficulty was encountered in peeling of aspen from some stands which had been completely defoliated. Light defoliation scattered in Clark, Jackson, and Monroe County aspen stands was less noticeable than in 1963.

Phenological Notes:

May 14 - Larvae were in the third instar in Clark County.

Jack Pine Budworm - *Choristoneura pinus* (Freeman)

Populations appeared to have increased generally throughout the Northwest Area. Moderate to heavy defoliation was apparent in some stands in Burnett and Polk Counties. Larval and pupal parasites were numerous, but egg mass counts indicated the overwintering population would be greater than it had in 1963-64. Parts of three townships encompassing about 6,000 acres of jack pine timber are being considered for chemical control in 1965.

A population decline continued in the Town of Stephenson in Marinette County where only light defoliation was encountered. Early instar larval counts were low in dense plantings and moderate on open grown trees in this area of frequently changing populations.

Light defoliation occurred in northern Adams and Juneau Counties where predators and parasites reduced a moderate early instar larval population to an insignificant level as the season progressed. Similarly, larval populations were low in other parts of the West Central Area, and they produced no noticeable defoliation.

Samples collected in the Northwest and West Central Areas to use in estimating the hazard for the summer of 1964, agreed well with what was observed in the field except that the activity in Burnett and Polk Counties was slightly underestimated.

Phenological Notes:

May 5	- First noted feeding in Polk County.
May 13	- All larvae in 2nd instar in Wood County.
May 19	- Mostly 2nd instar larvae in Marinette County.
May 20	- Two-thirds of the larvae in the 3rd instar in Wood County.
May 25	- First 4th instar larva found; most in 3rd instar in Jackson County.
June 8	- First pupa found in Adams County· most larvae in 5th instar.
June 19	- Pupation started in Polk County.
June 24	- Pupation started in Burnett County.
June 29	- Moths observed in Polk County.
July 1	- Moth flight in progress in Adams County.

ORTHOPTERA

Walkingstick - Diapheromera femorata (Say)

Two areas of infestation in Marinette County continued to shrink in size. Maps of the Girard Tower infestation, which covered parts of Sections 14, 23, and 24 in T35N, R18E, and the Silver Cliff infestation which included parts of Section 13, T34N, R17E, and Sections 17 and 18, T34N, R18E, were prepared from aerial survey sketches and notes (See page 28). These indicated only 300 acres of light to moderate defoliation in the Girard Tower vicinity compared to more than 1,000 acres of heavy to complete defoliation in the same locality in 1962.

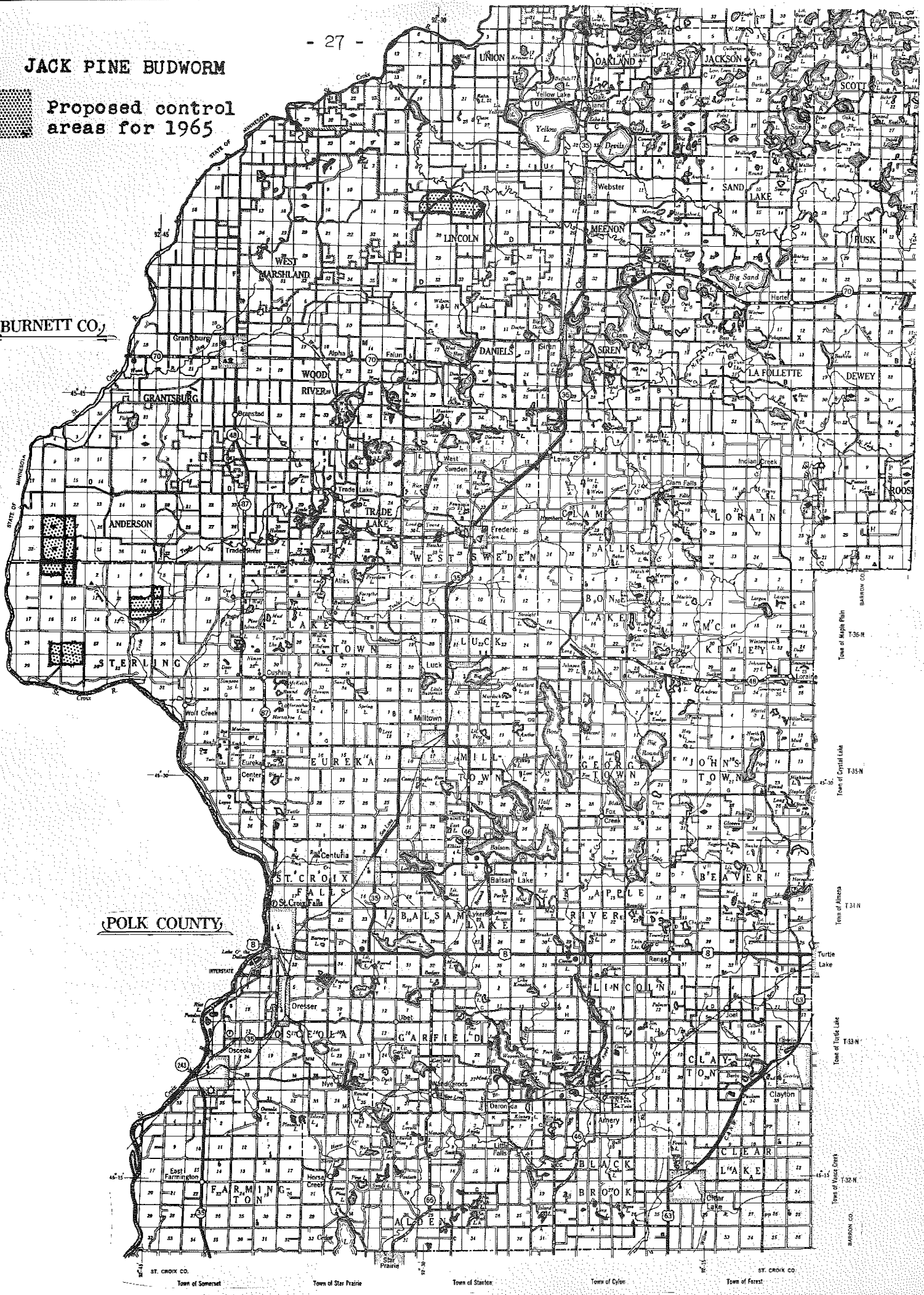
Moderate defoliation was mapped on three small patches for a total of about 350 acres in the Silver Cliff infestation, compared to 2,500 acres of heavy to complete defoliation in the same vicinity in 1962.

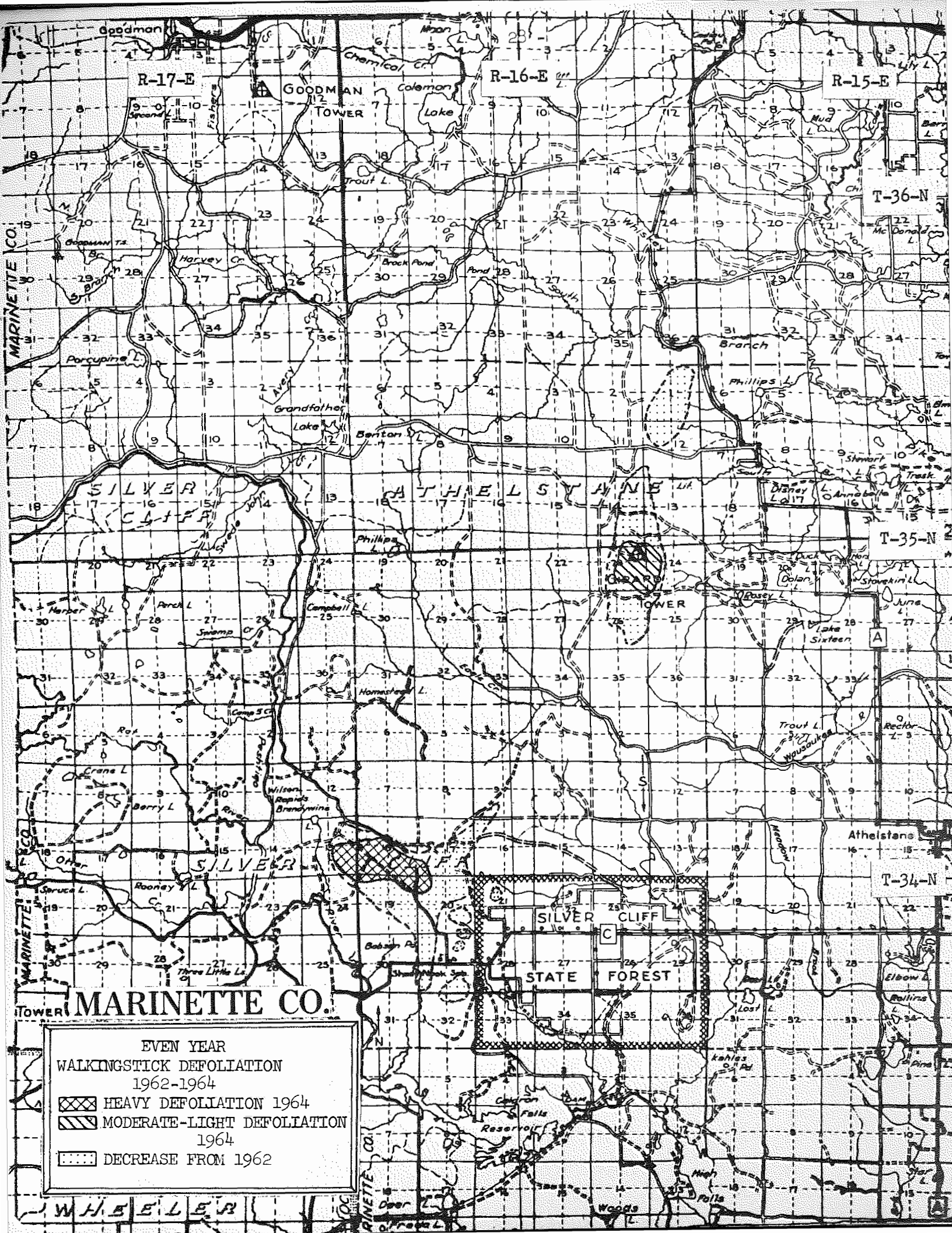
Defoliation was estimated and rated as follows:

Complete	- All foliage consumed.
Heavy	- 10% to 25% of the leaves remaining.
Moderate	- Between 25% and 50% of the leaves remaining.
Light	- Between 50% and 75% of the leaves remaining.
Negligible	- More than 75% of the leaves remaining.

JACK PINE BUDWORM

Proposed control areas for 1965




R-17-E
R-16-E
R-15-E
T-36-N
T-35-N
T-34-N
GOODMAN TOWER
SILVER CLIFF TOWER
SILVER CLIFF STATE FOREST
MARINETTE CO.
EVEN YEAR
WALKINGSTICK DEFOLIATION
1962-1964
HEAVY DEFOLIATION 1964
MODERATE-LIGHT DEFOLIATION 1964
DECREASE FROM 1962

Defoliation estimates were made on seven plots for two seasons, and eggs were collected in two one-foot-square screen covered traps on each plot during the same seasons. Egg counts indicated in the tabulation below represent the average of the total collections for the season in each pair of traps on each plot. Plots 4, 5, and 6 established in 1962 extended along a straight line from a zone of complete defoliation into the periphery of the infestation that year. The percentage of each of the sexes in the population late in the season are based on random counts of 100 to 300 walkingsticks collected on each plot. No counts were made on plot 4. The same high percentage of males has been observed previously in localities which had undergone heavy to complete defoliation.

The total number of eggs which dropped into 14 traps in 1964 was 123, and of these, 28 eggs, or 23% had parasite emergence holes. The largest total number of eggs collected during the 1964 season from a single trap was 24.

	Sept. 28, 1962		Oct. 13, 1964		
Plot No.	No. Eggs	Est. Defoliation	No. Eggs	Est. Defoliation	% Males
1	5.5	Complete	0.0	Negligible	75
2	17.0	Complete	2.5	Negligible	74
3	34.5	Complete	0.0	Negligible	75
4	39.0	Complete	13.5	Heavy	--
5	0.0	Light	8.5	Moderate	53
6	5.5	Light	24.0	Complete	51
7	10.0	Moderate	0.0	Negligible	76

As indicated in the tabulation, the population collapsed completely at plots 1, 2, 3, and 7.

Newly hatched walkingsticks were collected in Marinette County on June 4 and kept in a single cage at the Nevin Laboratory until June 15 when 10 nymphs were picked at random and placed in isolation in lamp chimney cages where they were kept until they died.

An attempt to obtain data on the number of molts was unsuccessful because nymphs were observed to consume exuviae as they were shed. A molt observed on July 2 required just two hours for completion. The insects were kept supplied with fresh red-oak leaves until they died and eggs were collected daily from the cages of the unmated females. The following table presents some of the data collected:

Cage No.	Sex	No. Eggs	Egg Laying Period (Days)	Average No. Eggs/Day	Life Span (Days)
1	Male				96
2	Female	132	41	3.2	94
3	Male				100
4	Male				--
5	Male				98
6	Female	141	38	3.7	89
7	Female	114	45	2.5	108
8	Male				110
9	Female	101	36	2.8	100
10	Female	167	40	4.2	93

The life span is based on a hatching date of June 1. On June 4 the new nymphs were on the underside of one-year-old seedlings and on leaves up to about 8 feet above the ground on larger trees. Very few nymphs were found on hazel brush and other low vegetation on that date, and hatching appeared to be underway only on higher ground in the vicinity where collections were made. On June 13 most nymphs were still in the first instar in Marinette County, although some were in the second, and all were moving up into the trees.

Hard frosts occurred in the area on June 17 and 18, and may have been a significant factor in reducing the population.

Third instar nymphs were predominant on July 13, and a few were in the fourth instar. Sexes were readily discernible and about 60% of the nymphs collected near the Girard Tower were females.

Egg traps were set in place on the plots on July 30. Oviposition appeared to be at its peak on September 1. The traps were collected and final observations were made on the plots on October 13.

Defoliation was light in the perennially infested Eau Claire County area. No noticeable defoliation occurred in the Buffalo County area that was first reported in 1963.

OTHER INSECTS REPORTED

Scientific Name	Common Name	Area(s)
COLEOPTERA		
Lyctus sp.	Powder Post Beetle	S
Monochamus sp.	Long Horned Borer	NW
HEMIPTERA		
Lecanium quericifix Fitch	Oak Lecanium	NE, S
Lepidosaphes ulmi (Linnaeus)	Oystershell Scale	NE
Phenacaspis pinifoliae (Fitch)	Pine Needle Scale	NW, NE, S
Pineus strobi (Hartig)	Pine Bark Aphid	NW, S
HYMENOPTERA		
Cimbex americana Leach	Elm Sawfly	NE
LEPIDOPTERA		
Bucculatrix ainsliella Murtfeldt	Oak Skeletonizer	NW
Bucculatrix canadensisella Chambers	Birch Skeletonizer	NW, WC
Coleophora laricella (Hubner)	Larch Casebearer	NE, S
Eucosma sonomana Kearfott	Jack Pine Shoot Borer	NW, WC
Malacosoma americanum (Fabricius)	Eastern Tent Caterpillar	NW, NE, S
Nymphalis antiopa Linnaeus	Mourning-Cloak Butterfly	NW, S
Petrova albicapitana (Busck)	Pitch Blister Moth	NW, WC
Rhyacionia buoliana (Schiffermuller)	European Pine Shoot Moth	EC
Tetralopha robustella Zeller	Pine Webworm	NW

MAJOR FOREST DISEASES

WILTS AND DIEBACKS

Oak Wilt - Ceratocystis fagacearum (Bretz) Hunt

Oak wilt continued to spread with many new infection centers observed in Iowa and Grant Counties. Oak wilt may be found in 44 of Wisconsin's 72 counties (See map on page 33).

Vapam barriers appear to be effective in preventing oak wilt spread through grafted roots. Vapam was used successfully in Nelson Dewey State Park in Grant County. An oak wilt control demonstration plot near Elkhorn in Walworth County indicated that larger amounts of vapam were necessary for disease control in clay than in sandy soils. Sandy soils rates are 1 part of vapam to 9 of water, while clay soils require 1 part of vapam to 4 of water. The Walworth County demonstration plot also showed that low toxicity arsenical compounds could be used in place of highly toxic sodium arsenite to poison trees and thus prevent root graft transmission of the fungus.

Oak Dieback - unknown

Reports of oak twig and branch mortality in Burnett, Polk, Rusk, Sawyer and Washburn Counties were received again this year. Several different species of fungi were present on affected branches collected in 1963. Identification of the fungi is pending.

Black Ash Dieback - unknown

Reports of black ash dying were received from Lincoln, Marathon, and Sheboygan Counties. The dieback reported in these counties may be the result of a combination of factors, mainly fluctuating water levels and late spring frosts.

Dutch elm disease - Ceratocystis ulmi (Buisman) Moreau

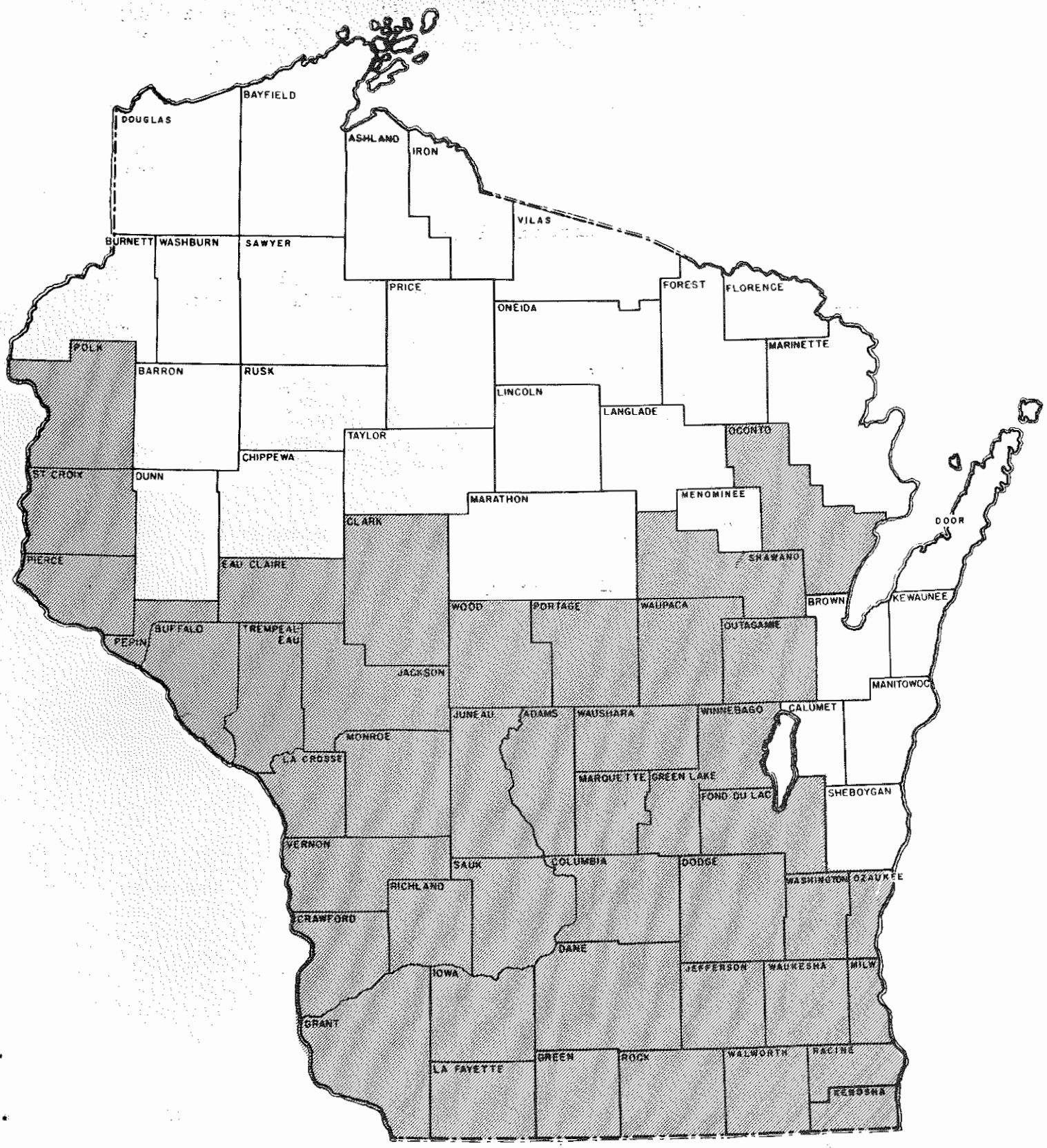
Dutch elm disease has been reported in 37 of Wisconsin's 72 counties. The disease is at its greatest intensity in southeastern Wisconsin and continues to spread north and west. A map showing the annual disease progression by counties may be found in Wisconsin Department of Agriculture's "1964 Dutch elm disease report".

ROOT AND BUTT ROTS

Nursery Root Rot - Cylindrocladium scoparium Morgan

This disease which has caused considerable mortality of pines and spruces in Wisconsin's forest nurseries. Control is now being attempted by soil fumigation and root dipping. Control measures based on University of Wisconsin and Conservation Department cooperative research are published in the following report:

Prey, A. 1964. Recommendations for the control of Cylindrocladium root rot in Wisconsin's forest tree nurseries, Forest Management Division, Wisconsin Conservation Department, mimeo., 9 p.



Known Distribution of Oak Wilt

Wisconsin - 1964

Annosus Root Rot - Fomes annosus (Fr.) Cke.

To date Fomes annosus root rot has not been found in Wisconsin. One means of detecting the fungus is by trapping spores in the air and culturing the fungus on discs cut from young pine trunks which acts as a selective medium for the fungus. In 1963, pine discs were exposed weekly in each of the five survey areas from May - June and September - October for periods of 8-24 hours -- in the spring and fall of 1964 similar exposures were made. Currently plans are being made for a more intensive survey as well as refining the spore trapping method.

Shoestring Root Rot - Armillaria mellea Valh. ex. Fr.

In Marinette County (NE$\frac{1}{4}$, Section 19, T32N, R19E) a 160-acre, 25 year old jack pine plantation had numerous Armillaria mellea infection centers present. In 1957 the plantation was damaged by jack pine budworm and in 1958-59 the mature and orchard type trees were removed. By 1964 A. mellea had partially decayed these stumps and the fungus was isolated from the roots of adjacent trees. Some of the infected trees had thin crowns, bark beetle galleries or dead tops. But many trees with root infections at least 15 feet from the main trunk did not show crown symptoms.

Note: Sporophores were fruiting on September 9 in Oconto County.

STEM AND BRANCH DISEASES

Hypoxylon Canker (Hypoxylon pruinatum) (Kl.) Cke.

Hypoxylon canker continues to be a problem in Wisconsin, especially in areas where the annual growth of aspen exceeds the annual cut. Surveys by the Lakes States Forest Experiment Station indicate that in Wisconsin hypoxylon canker kills two percent of the standing aspen annually.

FOLIAGE DISEASES

Pine Needle Blight - Dothistroma pini Hulbray

Dothistroma pini was first reported on Austrian pine in Wisconsin in 1963. A survey the same year indicated the disease was also present on Mugo and Ponderosa pine but not on Scotch or red pine. In 1964 most Austrian pine plantations inspected had the fungus present.

Two plantations noted in 1964 are:

Adams County, 3-5 acres, SESE Section 17, T23N, R5W

Jackson County, 1 acre, SWSW Section 12, T18N, R7E

Pine Needle Rust - Coleosporium solidaginis (Schw.) Thuem. = C. asterum (Diet.) Syd.

In 1962 and 1963 Department foresters recorded locations and dates of aerial fruiting. Data were given to the University of Wisconsin

and the Lakes States Forest Experiment Station for use in an epidemiological study. In 1964 the results were summarized in a thesis at the University.

Nicholls, T. H. 1964. Life cycle and seasonal development of Coleosporium pine-needle rust in Wisconsin, M.S. Thesis, University of Wisconsin.

OTHER PROBLEMS

Plantation Deterioration

In Iowa and Lafayette Counties mixed plantings of red and white pine were found in a deteriorated condition. Many of the trees showed thin foliage, poor color, and reduced height growth. Pockets of dead and dying trees were increasing due to bark beetle attacks. Examination of the root systems did not reveal any root rot organisms but soil tests indicated the sites were not suitable for good tree growth. Most of the areas had a thin soil layer and calcareous bedrock (pH 8.0). However, in one area red and jack pine were established on sandstone bedrock.

The plantations are located as follows:

Iowa County (red pine)	- SW, SE, Section 23, T6N, R5E
Iowa County (red pine)	- SW, SE, Section 1, T5N, R3E
Iowa County (red and jack pine)	- NW, NE, Section 28, T5N, R5E
Lafayette County (red and white pine)	- NE, SW, Section 34, T3N, R3E

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